EXHIBIT H

Expert Rebuttal Report of Dr. Loren Collingwood

Loren Collingwood

2024-08-30

Executive Summary

I have been retained by plaintiffs as an expert in the case entitled "Rodney D. Pierce et al. v. The North Carolina State Board of Elections," and have provided an initial report dated May 31, 2024 ("Collingwood May Report"). In this rebuttal report I respond to Dr. John Alford and Dr. Sean P. Trende's respective reports. In forming my opinions, I have relied on my original analysis and associated data production, as well as Drs. Alford and Trende's reports and associated data production.

Based on my review of the two aforementioned reports, I conclude the following:

- The race of the voter is what determines whether a contest is racially polarized, not the race of the candidate.
- The suggestion that a district in this region would perform at 37% BVAP relies on a methodologically flawed analysis by focusing on only precincts and not districts as a whole.
- Dr. Trende overstates the margin of error (MOE) for Black citizen voting age percentage (CVAP%) in Mr. Esselstyn's illustrative districts. His code demonstrates that he made a series of basic errors, including erroneously including block groups that were not in the districts, failing to properly square numbers and inverting elements of the accepted formula to calculate MOE estimates for a proportion, such as Black CVAP%.
- By relying only on block group MOEs as the unit of analysis to generate MOEs, Dr. Trende significantly inflates the estimated margin of error for the Black CVAP% in Mr. Esselstyn's illustrative districts.
- A simple comparison of the MOE results Dr. Trende's method produces at the county level – where we have known MOE estimates directly from the Census Bureau – shows how wildly inaccurate it is here to use only block group MOEs to estimate the MOE of a given region.
- By combining known county-level MOEs for counties that are kept whole in an illustrative district with block group MOEs for split counties, we can estimate the MOE for illustrative districts more accurately. Based on the most recent 2022 ACS data, Mr. Esselstyn's Demonstration District E has a Black CVAP% that is above 50%, even taking into account the margin of error at the 90% and 95% confidence level.
- Demonstration District E also electorally performs for Black voters, with Black-preferred candidates winning in all 49 contests I examined.

- Dr. Trende's racial dot plot maps distort the actual racial distribution of voters in the area he depicts. For instance, among only white and Black VAP, about 40% of Pasquotank's VAP is Black, but his dotplots make this number appear half that. A simple change to Dr. Trende's code produces a more accurate representation.

I am being compensated at a rate of $450/hour. My compensation is not contingent on the opinions expressed in this report, on my testimony, or on the outcome of this case.

Voting in Northeastern North Carolina is Highly Racially Polarized

Dr. Alford and I produced nearly identical ecological inference estimates for 49 contests spread across multiple jurisdictions. We both show that Black voters consistently prefer a set of candidates and that white voters consistently prefer a different set of candidates. Dr. Alford does not dispute that Black voters are cohesive, that there is significant white bloc voting in the areas I examined, and that as a consequence of this significant white bloc voting, white voters are usually able to defeat the preferred candidate of Black voters. In other words, Dr. Alford does not dispute that Gingles factors 2 and 3 are satisfied.

Dr. Alford instead makes the case that Black voters do not prefer Black Democratic candidates any more or less than they do white Democratic candidates. But he does not explain how such a result, even if it were true, would undermine my finding that voting in North Carolina is highly racially polarized based on the race of the voter. This is not to say that the race of the candidate is not or may not be important in certain contexts. But the race of the voter determines candidates of choice. If Black voters happen to prefer a white candidate because that white candidate makes strong cross-racial appeals and/or takes policy stances that are in line with the policies and issues Black voters care about, then it is sensible that that candidate is Black voters' candidate of choice.

That is why the test to examine whether there is racially polarized voting is most typically a bivariate test (voter's race and their vote choice). On this, the results are indisputable – northeastern North Carolina is characterized by racially polarized voting and extremely strong Black minority cohesion.

In any event, none of Dr. Alford's analysis supports a conclusion that partisanship, rather than race, drives the extreme racially polarized voting in this area. Dr. Alford's own results demonstrate that minority-preferred minority candidates are defeated more often in this area of the state than minority-preferred white candidates. (I understand that the Fourth Circuit's recent opinion mentioned that a district court, in rejecting an argument that partisanship was the cause of racially polarized voting, had "considered evidence that minority-preferred minority candidates were defeated more often than minority-preferred white candidates, and that white voters offered less cohesive support to minority Democratic candidates than to white Democratic candidates.") As I reported in my initial report, over the four election cycles I considered, the 2016 cycle was the only year where a Black-preferred candidate won a majority of the vote in Senate District 1 or 2 in any of the election contests I examined, and so I will focus my comparison on that year. There were 18 statewide election contests in 2016, and 6 Black-preferred candidates won either in

Senate District 1, Senate District 2, or both.[1] Notably, of those 6 winning Black-preferred candidates, 5 were White – all candidates except Justice Morgan. In total, Dr. Alford reports (in his Table 4) that 6 minority-preferred minority candidates ran in 2016; my Table 2 shows that that 5 of them, or 83%, were defeated in Senate Districts 1 and 2. By contrast, Dr. Alford's Table 4 reports that 12 minority-preferred White candidates ran in 2016; my Table 2 shows that 7 of them, or 58%, were defeated in Senate Districts 1 and 2. These results reflect that minority-preferred minority candidates are defeated more often in Senate Districts 1 and 2 than minority-preferred white candidates. I cannot conduct this comparison for the more recent election cycles because the minority-preferred candidates did not win a majority of the vote in any election I examined.

Likewise, although the differences are only a few percentage points, Dr. Alford's own results demonstrate that white voters offered less cohesive support to minority Democratic candidates than to White Democratic candidates in certain election years. His Table 4, which matches RPV estimates to the race and party of the candidates in 2016, shows that white voters in all three relevant areas—the Demonstration Area, Senate District 1, and Senate District 2—were more likely to vote for a White Democrat than a Black Democrat. On average, 21% of White voters in the Demonstration Area, 25% of White voters in District 1, and 22% of White voters in District 2 supported a White Democrat in 2016 races. By comparison, on average, 18% of White voters in the Demonstration Area, 23% of White voters in District 1, and 20% of White voters in District 2 supported a Black Democrat in 2016 races. White voters were slightly less likely across the board to support Black Democrats. Dr. Alford acknowledges that the 2016 contests "show a[] consistent tendency for White voters to crossover at lower levels for Black Democratic candidates." Report at 11.

In 2020 and 2022, Dr. Alford reports in his Table 6 and Table 7 that White voters were sometimes equally likely to support minority Democratic candidates, and sometimes slightly less likely (in District 2 in 2020 and the Demonstration Area in 2022, though the difference is only 1 percentage point). In 2018, Dr. Alford reports that White voter support was equally cohesive, although the data for comparison in that cycle is very limited, as there were only 4 statewide races, and only one involved a Black candidate. The 2018 election cycle accordingly is not a good source for analyzing differences in support between minority Democratic candidates and white Democratic candidates.

I note that comparing all racially polarized voting figures within the same election cycle, in circumstances like 2016 where there were many races with both Black and White candidates, is more useful than selecting a handful of contests for a particular type of office and comparing across years. For example, Dr. Alford's comparison in Table 1 of racially

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[1] As Table 2 in my original report reflects, the Black-preferred candidates who won the majority of the vote were Marshall in the 2016 Secretary of State contest, Wood in the 2016 Agriculture Commissioner contest, Goodwin in the 2016 Insurance Commissioner contest, Atkinson in the 2016 Superintendent of Public Instruction contest, Morgan in the 2016 state Supreme Court contest, and Stephens in a 2016 Court of Appeals contest.

polarized voting in a single Senate race involving a Black Democratic candidate (in 2022) to two Senate races involving White Democratic candidates in different years (2016 and 2020) does not provide sufficient data to support his broad conclusion based on this Table that "the race of the candidates does not appear to have a polarizing impact on vote choice." Report at 6. An analysis based on support for one or two Black candidates is not reliable, especially when these contests are happening in different years.

The only cross-year, single office comparison Dr. Alford offers that involves a larger number of Black candidates is in Table 3, where he compares 17 state appeals court elections, 7 of which involved Black Democratic candidates and 10 of which involved White Democratic candidates. White voters supported the White Democrat candidates on average at rates of 15% in the Demonstration Area, 22% in Senate District 1, and 19% in Senate District 2. By contrast, White voters provided slightly less cohesive support to the Black than to the white Democratic candidates, at 14%, 21%, and 18% in those respective areas.[2] Again, the differences are not large.

Dr. Alford also points out the lack of white cohesion in the 2016 Supreme Court 2 contest – which was the last non-partisan contest. For a non-partisan contest, we do observe a fairly high rate of cohesion among Black voters. Non-partisan State Supreme Court races are typically considered to be low information voting affairs, meaning that many voters would have little information to go on when choosing their preferred candidate. The two candidate surnames are not especially racially distinctive from one another – both Black and white folks might realistically have either of those names. Moreover, voters likely would suffer from ballot fatigue – they were asked to vote on 18 separate statewide contests. These factors combine to produce significantly lower voter turnout in this single contest: Of the eligible 6,914,248 registered voters in 2016, 4,769,640 (68.98%) cast a vote for any contest in the general election. The numbers drop slightly for the 2016 presidential contest: 4,741,564 voters cast ballots (68.6%), and then quite a bit more for a Court of Appeals contest (Position 4) featuring strong racially polarized voting between Stephens and Berger (4,445,361 cast votes, 64.3%). However, turnout for the contest between Edmunds and Morgan dropped to 3,961,352 total voters, or 57%.[3] And as noted above, every other Black candidate on the statewide ballot in 2016 lost in Senate District 1 and Senate District 2.

Finally, Dr. Alford asserts that "party affiliation of the candidates *best explains* the divergent voting preferences of Black and White voters." Report at 19 (emphasis added). But he performs no analysis of that question at all and does not explain his conclusion. Even if

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[2] Dr. Alford's average in Table 3 does not include the Cubbage race, even though Cubbage was a Black Democrat who received low support from White voters. Dr. Alford presumably excluded her from the average because she faced a Black Republican. Since I am focusing on whether white voters offered less cohesive support to minority Democratic candidates than to white Democratic candidates, I have added the results from her contest (reported elsewhere in Dr. Alford's Table 3) to create these averages.

[3] https://www.ncsbe.gov/results-data/voter-turnout#general

Dr. Alford were correct that voters do not vote on the basis of the race of the candidate, nothing in his analysis shows or even attempts to show that Black voters in North Carolina in any contest are cohesively voting for a particular candidate because that candidate is a Democrat, as opposed to because Black voters cohesively believe that the particular candidate will advocate for their community.

Thus, Dr. Alford selects a clear outlier contest to contend that voting is less polarized in non-partisan contests. But the fact remains that of the 49 contests analyzed we do see stark minority cohesion and consistent RPV between white and Black voters across all the analyzed jurisdictions.

BVAP Analysis

In my original report, I conducted a statistical analysis and simulation, using RPV results and turnout numbers, to determine the BVAP percentage at which a district in the relevant region would elect a Black-preferred candidate. Using the results of all statewide elections in the two most recent cycles, I concluded that 47.07% is the best fit BVAP estimate that on average (i.e., not always) would enable Black-preferred candidates to achieve a narrow 50%+1 victory. Dr. Alford does not respond to or dispute this analysis, and in fact he appears to endorse it on page 15 of his report.

In his Figure 2, Dr. Alford creates a chart plotting the BVAP% of each precinct in my 12-county demonstration region and the percentage of the vote within each precinct that goes to the Democrat in the 2020 Governor election. He states that precincts with 37% BVAP begin to support Democratic candidates, in this case Roy Cooper for governor. It is unclear if Dr. Alford is suggesting that this chart provides any evidence that a Black-preferred candidate could win in a district in this region with 37% BVAP, but any such suggestion would be incorrect. Dr. Alford's chart provides no reliable evidence about the BVAP% required to win a district.

First, precincts vary widely in population. If the average precinct, adjusted for population, elected a Black-preferred candidate at 37% BVAP, that information might provide some relevant evidence about the BVAP needed. But the fact that a single precinct does so tells us nothing.

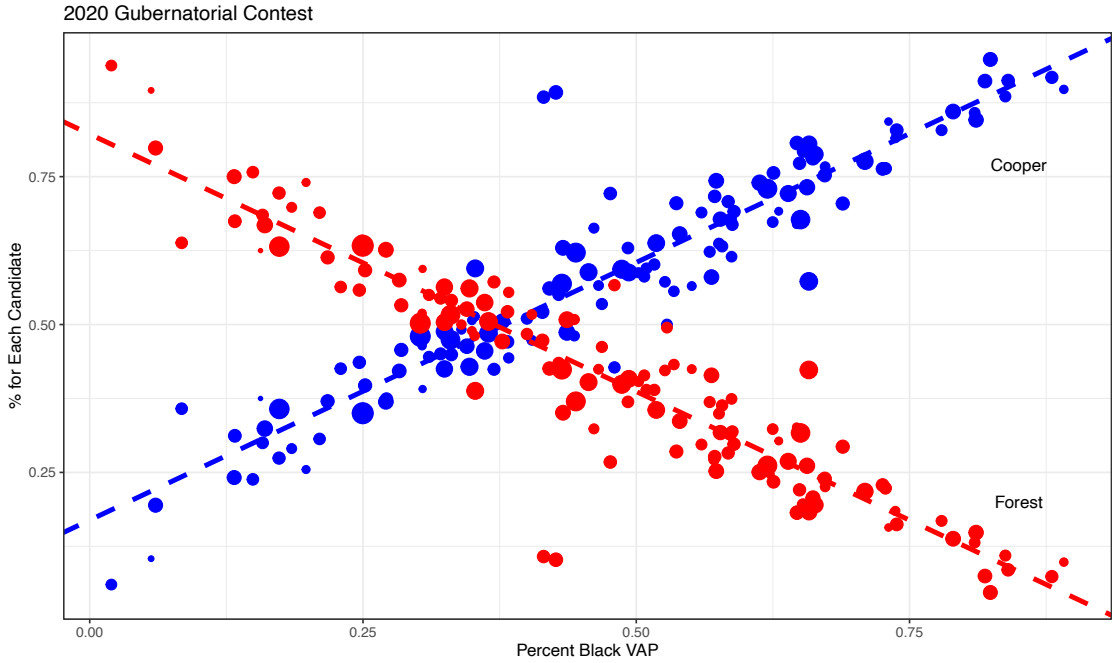
Second, the performance of each precinct varies widely, as Dr. Alford's chart reflects. His analysis tells us nothing about the location of the precinct that performs at 37% and whether it is possible to draw a district around that precinct that includes other precincts that will also perform at 37%, or that will perform on average at 37%. Another reason one cannot reliably draw conclusions from a single precinct cut-point analysis (i.e., BVAP = 37%) is the possibility that white voters who live in more racially mixed areas are politically different from white voters residing in more homogeneous areas. In this case, because we know that Black voters are extremely cohesive we can be pretty confident that they will back the Black-preferred candidate at high rates whether a Black voter lives in a racially mixed area or a very Black area. White voters, on the other hand, are not as cohesive – overall 11.6% of White voters voted for the Black-preferred candidate in 2022

in the Demonstration Area, for example. These votes are not evenly distributed throughout the Demonstration Area, and white voters may be more likely to vote for the Black-preferred candidate in racially mixed areas. In this way one 37% BVAP precinct might comprise a completely different composition of white voters than would a full district drawn from the demonstration area where EI estimates showed white voters giving Governor Cooper just 15.4% of their vote as a whole. See Figure 19 of my original report.

Third, if Dr. Alford claims that a 37% BVAP district could elect a Black-preferred candidate, then he or one of Defendants' other experts should submit a demonstrative map in this region that abides by traditional redistricting principles and that performs for Black-preferred candidates using standard performance analysis techniques. He has not done so.

Simply looking at one or two charts of precincts (Dr. Alford's Figures 2 and 3) does not allow us to identify any outliers or unusual patterns that might make a particular precinct of 37% BVAP vote more for a Democratic candidate. I have replicated Dr. Alford's 2020 plot but with weighted (by total governor vote) dots to show that not all precincts should be treated equally in such an analysis.

Rebuttal Figure 1. X-plot showing 2020 gubernatorial candidate vote as a function of precinct BVAP racial demographics.



Fourth, Dr. Alford's analyses are based on just two elections, whereas my analysis and conclusion is derived from 27 elections (all 2020 and 2018 statewides). Focusing only on the governor's contests – while appropriate in conjunction with other races – provides a somewhat limited analysis because Roy Cooper tends to over-perform in the state and so the Black VAP required to elect him would likely be lower than would be required in other contests in a given year. For example, while Cooper won fairly handily (for a battleground state like North Carolina) in 2020, in that same election year Trump narrowly defeated

Biden. Fifth, looking at the empirical data demonstrates why using a single precinct cut-point to set the "winning" Black percentage is a mistake. I examined how the four precincts in the Demonstration Area with BVAP between 37-40% performed in the 2020 governor and presidential contests.[4] Table 1 shows that Cooper, the Black-preferred gubernatorial candidate, wins two of the four precincts. But the vote percentage in the four precincts as a whole shows Forest narrowly winning those four precincts, 49.8% vs. 48.9%. The presidential contest, moreover, shows the Black-preferred candidate (Biden) narrowly losing in each precinct, and losing 46.7% to 52.6% (Trump) overall in the four precincts.

Rebuttal Table 1. 2020 elections results in precincts with BVAP between 37-40%. Demonstration area.

Precinct	County	VAP	PBVAP	PresVote	DemPres	RepPres	PDemPres	PGOPPres	GovVote	DemGov	RepGov	PDemGov	PGOPGov
PRECINCT 3	GATES	1987	0.377	1486	728	744	0.49	0.501	1466	741	691	0.505	0.471
CREEKSVILLE	NORTHAMPTON	647	0.383	488	200	286	0.41	0.586	487	216	270	0.444	0.554
CENTER HILL	CHOWAN	895	0.4	684	325	354	0.475	0.518	686	350	332	0.51	0.484
FAUCETT	HALIFAX	1342	0.382	903	409	488	0.453	0.54	905	426	472	0.471	0.522
Total		4871	0.384	3561	1662	1872	0.467	0.526	3544	1733	1765	0.489	0.498

Ultimately, to examine the BVAP required to typically elect a Black-preferred candidate, it makes sense to do what I did in my initial report – analyze the full area where a district could be drawn, based on a large set of elections – rather than formulating conclusions based on a single precinct inflection point.

Dr. Trende's CVAP Analysis

Dr. Trende suggests that Mr. Esselstyn's B-1 and D-1 demonstrative districts may not be majority Black CVAP districts by suggesting that incorporating the margin of error (MOE) means that the point estimates for those districts might fall below 50%. Dr. Trende's margin of error calculations are fundamentally flawed, however. That is true on his own terms – he makes calculation errors and uses the wrong block groups, which renders every single margin of error calculation in his report wrong even on his own terms. His methodology is also fundamentally flawed and has the consequence of vastly inflating the

[4] For each precinct I divided each candidate's precinct vote by the total vote cast in that precinct – including minor-party candidates. For instance, in Precinct 3 (row 1 of Table 1), Joe Biden notched 728 votes, Trump 744, and there were 1486 total presidential votes cast. Therefore Biden receives a percentage score of 728 / 1486 = 0.4899, and Trump a score of 744 / 1486 = 50.01 (rounded). The totals row first sums each candidate's total votes, then divides by total votes in that contest. For instance, Biden received 728, 200, 325, and 409 respective votes in the four precincts for a total of 1,662 votes. There were 1486, 488, 684, and 903 total votes cast for president in each respective precinct for a total of 3,561 votes. Therefore, 1,662 / 3,561 = 46.7%.

actual margin of error. In this section of the report, I explain the flaws in Dr. Trende's analysis and calculate correct margins of error.

One of his arguments rests upon how the American Community Survey (ACS) publishes its 5-year data. The ACS publishes 90% MOE estimates at the block group level – but some of Mr. Esselstyn's districts split block groups, making MOE calculation technically impossible based on the reported block group point estimates and margins of error.[5] On page 15, Dr. Trende states, "those estimates do not have known error margins or published failure rates."

Beginning on page 16, Dr. Trende spends considerable time discussing block groups and sampling error with a particular focus on one of the block groups in Mr. Esselstyn's B-1 map. On page 18 he states, "When we disaggregate the data, however…there's no known way to estimates the error downwards." This is the point I make above. But based on my experience, it is routine in VRA cases for courts to accept illustrative maps with split block groups, even where the population estimate relies on CVAP. Dr. Trende appears to make the case that one cannot draw an illustrative map with split block groups in a VRA case because the Census does not provide MOE data at all units. I am unaware of any court ruling accepting such a suggestion.

Ultimately, Dr. Trende calculates margin of error by focusing on block group as the lowest unit. For areas that split block groups, I agree that using block group as the lowest unit, and not attempting to disaggregate MOE down from the block group to the block, is the correct procedure to calculate MOE. As explained in more detail below, however, using block group MOEs to calculate MOE is not appropriate in circumstances where counties are kept whole and it is possible to use a larger unit with a lower (and more precise) MOE.

Below I describe the errors in Dr. Trende's calculations.

CVAP MOE calculation

Because the ACS data has three categories that include Black citizens, Dr. Trende aggregated these three categories together to get the full Black CVAP estimate. The Redistricting Data Hub (RDH)[6] provides the aggregated numbers, stating:

> "To improve the usefulness of the data, we have modified three categories to correspond with the Office of Management and Budget (OMB) racial categories. The"Alone" categories for American Indian or Alaska Native (fields with "AIA"), Asian (fields with "ASN"), and Black or African American (fields with "BLK") represent an encompassing racial category that is inclusive of all categories that

[5] We can disaggregate the block group point estimates and MOEs down to the block then calculate MOEs but this method is ultimately imperfect because we are still making spatial assumptions about where in a block group residents live.

[6] All experts involved in this last round of reports (Alford, Collingwood, Esselstyn, and Trende rely on RDH data in their reports over the years.)

include that race… For CVAP_BLK20, the field would be the sum of the original CVAP_BLK20, CVAP_AIB20, and CVAP_BLW20."

I compared Dr. Trende's calculation of Black 2020 CVAP MOE against those generated by RDH, by examining block group MOE estimates in the region. For expository reasons I focus on block group 370010201001. Both data sources (Dr. Trende's block group data and RDH) indicate the total 2020 Black CVAP is 105, and Total CVAP is 970. However, for Black CVAP, the MOE from RDH is 72.37, whereas Dr. Trende's code reports 70.19 (rounded to two decimal points). This error is replicated for every single one of his block groups.

This is because Dr. Trende used the wrong formula. Upon inspection of Dr. Trende's R code, Dr. Trende calculates the MOE by taking the square root of the following MOE sums: Black MOE squared + Black/White MOE + Black/Native MOE. The correct formula would sum the squares of all of the three summed race categories: Black MOE squared + Black/White MOE squared + Black/Native MOE squared, and then take the square root.[7]

The correct formula produces a 72.37 MOE figure – which matches RDH's estimate. I also validated this against the `moe_sum()` function in tidycensus – which is an R package both Dr. Trende and I routinely rely on to conduct demographic and geographic analysis.

This error is replicated throughout Dr. Trende's analysis, including for his analysis of the MOE of each block group using 2022 CVAP data. In the same block group referenced above (370010201001), Dr. Trende's code calculates the total Black MOE at 78.18 (rounding to 2 decimal places), whereas my correction estimate calculates the Black MOE at 80.47. The RDH data report a Total Black MOE of 80.47.

Because he analyzes the MOE of the Demonstration Districts using the MOEs from block groups, the error itself renders all of the MOE numbers he reports for Demonstration Districts B and D incorrect and unreliable.

This first error relates to the calculation of the MOE for the raw Black CVAP estimate, i.e., the total number of Black citizens of voting age in a particular block group. Dr. Trende then makes another error: he uses the wrong formula to calculate the MOE for the ultimate proportion at issue, namely the Black CVAP percentage.

Dr. Trende states in his report that he compiles the margin of error for Black CVAP percentage for the full demonstration district by relying on the instructions in the ACS handbook. (Trende Rep. 24 n.8). The proportions formula in the ACS handbook tells us how

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[7] See https://www2.census.gov/programs-surveys/acs/tech_docs/accuracy/MultiyearACSAccuracyofData2015.pdf. The Census Bureau's handbook on calculating MOE for ACS data, available at https://www.census.gov/content/dam/Census/library/publications/2018/acs/acs_general_handbook_2018_ch08.pdf, explains that, when combining multiple components, the steps are to: "1. Obtain the MOE of each component estimate. 2. Square the MOE of each component estimate. 3. Sum the squared MOEs. 4. Take the square root of the sum of the squared MOEs."

to calculate the MOE on a proportion, say, the percentage of the citizen voting age population that is Black. For this section, I focus on illustrative district B-1, but replicate the analysis for D-1 as well. The correct formula can be found on page 6 (internally labeled 56) in the ACS MOE calculation document.[8] The correct formula is formula 6:

$$MOE(\hat{P}) = \frac{1}{\hat{Y}}\sqrt{\left[MOE(\hat{X})\right]^2 - \left(\hat{P}^2 * \left[MOE(\hat{Y})\right]^2\right)}$$

where $\hat{P}$ is the proportion of X over Y, in our case x is Black CVAP, and y is total CVAP.

$$\hat{P} = \frac{\hat{X}}{\hat{Y}}$$

However, Dr. Trende employs the code incorrectly or does not rely upon the known formula. The code snippet below is taken directly from Dr. Trende's production. The goal of this code is to produce a margin of error on the proportion of Black CVAP to total CVAP, which Dr. Trende reports as +/- 1.8% (rounding up from 1.76%) at the 90% confidence level using 2020 CVAP data for illustrative district B-1.

One can see that the formula below is similar to the formula above from the ACS handbook, except that the code swaps the $\hat{X}$ (cvap_black_total_moe_90) and $\hat{Y}$ (cvap_moe_90) and does not square $\hat{P}$. Instead the cvap_moe_90 is placed where the $\hat{X}$ should be and vice versa.

```
b1_cvap %>%   mutate(moe = 1/cvap * sqrt(cvap_moe_90^2 -
(cvap_black_total/cvap * cvap_black_total_moe_90^2)))
```

The correct code would be:

```
b1_cvap %>%   mutate(moe = 1/cvap * sqrt(cvap_black_total_moe_90^2 -
(cvap_black_total/cvap)^2 *cvap_moe_90^2))
```

Dr. Trende's error has the effect of growing the margin of error. When the correct proportions formula is applied using the correct code, using Dr. Trende's exact data we arrive at a 2020 BCVAP% district B-1 MOE 90% confidence level estimate of +/- 1.34% – about half a percentage point lower than Dr. Trende's for the B-1 map. When I make the other adjustment for the multi-Black category summation to correct for Dr. Trende's other incorrect formula, the MOE 90% confidence level estimate shifts to +/- 1.36%. These figures are significantly lower than the 1.8% MOE Dr. Trende reports at the top of page 24.

For 2022, the BCVAP% district B-1 MOE (90% confidence level) is +/- 1.28% – without accounting for the Black category summation error. When accounting for said error, the MOE 90% confidence level estimate is 1.31%. This is quite a bit lower than the 1.8% figure

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8 https://www.census.gov/content/dam/Census/library/publications/2018/acs/acs_general_handbook_2018_ch08.pdf

that is produced when I ran Dr. Trende's code. (He does not appear to present that figure in his report – the 1.8% he does reference appears to be based on 2020 data).

I confirmed this finding by comparing against the `moe_prop()` function from the tidycensus package – which produces the exact same result as the calculation above.

Using the same approach, I find a similar result for Dr. Trende's calculations about Demonstration District D-1. For the 2020 data, I derived a margin of error of +/-1.32% at the 90% confidence level. When I make the adjustment for the multi-Black category summation, the MOE 90% confidence interval estimate shifts to +/- 1.33%. These numbers are significantly smaller than compared to the +/- 1.7% MOE at the 90% confidence level that Dr. Trende reports (at page 24 of his report).

For the 2022 data, I derived a margin of error of +/-1.28%. When I make the adjustment for the multi-Black category summation, the MOE 90% confidence interval estimates shifts to +/- 1.31%. These numbers are both significantly smaller compared to the +/- 1.8% that Dr. Trende reports for the MOE for Demonstration District D using the 2022 CVAP numbers.

Dr. Trende's calculations using a 95% confidence interval rely on the same erroneous code and are equally unreliable.

Finally, Dr. Trende makes a third basic error. As described further below, an inspection of his maps reflects that he has mistakenly assigned two additional block groups to Demonstration District B-1 and D-1 that are not actually in those districts, even in part. Those two block groups are "371399606001" and "371399607012," and his R code reflects that this MOE calculations incorporate the MOE from these additional block groups. All of his MOE calculations are inaccurate for this reason as well.

Using Block Groups to calculate MOE massively inflates MOE

The above three calculation errors, however, are not the most misleading aspect of Dr. Trende's MOE calculations. Due to the large sampling errors at the block group level, relying on block group MOE data to calculate MOE at the district level is inappropriate in situations where we can rely on more accurate county-level MOE calculations that the Census Bureau reports directly. Instead of using block group data for an entire district, we can use known county level MOE estimates for all full counties included in a district, and then combine that with block group level CVAP and MOE estimates only for the portions of a district that split a county. This should provide us a considerably more accurate MOE calculation, especially when the districts at issue include many whole counties and split only one county.

The fact that Dr. Trende's method of exclusively using block group data inflates the overall MOE can be empirically demonstrated by looking at the ACS's reported county by county margins of error for Black CVAP at the 90% confidence interval, and comparing that against what Dr. Trende's block group MOE method produces for that same county. In other words, using Trende's method – and even the method that adjusts the formula to correct Dr. Trende's mistakes described above – we can compare what Dr. Trende's MOEs look like

against known MOEs reported from the ACS at the county level. To calculate the county-level estimate using Dr. Trende's block-group derived method, I just ran his R code that he used to calculate the MOE for a demonstration district, but only include the block groups that are within each respective county.

Below in Table 2 I present the full counties included in Demonstrative B1, along with their 2022 CVAP total estimates and Black alone / Black + white / Black + Native American combined categories. The first column lists the county. The second column (TotalCVAP) lists the 2022 Total CVAP numbers reported by the ACS. The third column (CVAPMOE) is the margin of error for Total CVAP at the 90% confidence level, again reported directly by the ACS. The next two columns are the Black CVAP total and its margin of error based on the county-level ACS (combining the three categories that include Black citizens of voting age population). The column labeled BCVAPMOE is derived from taking the square of each reported MOE by the ACS for Black alone / Black + white / Black + Native American in each county, then summing those numbers, then finally taking the square root. This is the same method I discussed above.

The next column is the Black CVAP percentage in each county based on the ACS county level totals. Finally, I include three columns that are Dr. Trende's Block Group derived MOE method, Dr. Trende's adjusted method where I account for the summation and formula errors discussed above, and then the actual MOE using reported county level data from the ACS. As a reminder, these are MOE estimates for the proportion of citizen voting age population voters that are Black.

A quick perusal of the MOE estimates shows that Dr. Trende's county-level estimates based on the block group method are wildly incorrect – whether one uses Dr. Trende's calculations or the adjusted calculations that correct the errors described above. For instance, Dr. Trende's MOE estimate for Bertie County is more than seven times greater than the county estimates that the Census Bureau reports. Under Dr. Trende's method, Bertie County's Black CVAP% in 2022 of 61.2% would be subject to a margin of error of 5.49% in either direction, when the Census Bureau data reflects a MOE of 0.72%. In other words, Dr. Trende's block group only methodology produces a MOE that is 7.625 times higher than the known MOE calculated from the Census Bureau MOE figures.

Rebuttal Table 2. Analysis comparing various ways for estimating CVAP MOE shows that Dr. Trende's block group method produces highly unrealistic and unreliable MOE estimates.

County	TotalCVAP	CVAPMOE	BCVAP	BCVAPMOE	PctBlack	P_MOE_Trende	P_MOE_Trende_Adj	P_MOE_Cen
Bertie	14705	45	9000	110	61.2	5.49	4.4	0.72
Chowan	10970	180	3705	74.04	33.77	8.05	4.77	0.39
Gates	8290	141	2685	208.01	32.39	8.41	5.54	2.45
Halifax	37655	273	20060	351.97	53.27	3.8	3.13	0.85
Hertford	17180	101	10350	196.51	60.24	3.81	3.2	1.09
Martin	17375	89	7315	143.55	42.1	6.49	3.51	0.8
Northampton	14305	82	7870	225.22	55.02	5.1	4.15	1.54
Pasquotank	31225	240	11440	194.93	36.64	5.44	3.48	0.56
Warren	15105	81	7640	151.53	50.58	5.06	3.9	0.97

The block group only method produces erroneously large margins of error not just for proportions but also for the MOE on the point estimate itself. For instance, in Bertie County, the known Total CVAP MOE is reported by the Census Bureau at the 90% confidence interval as 45 (point estimate for total CVAP is 14,705). Dr. Trende's method produces a MOE of 1083.05 at the 90% confidence interval. Dr. Trende's calculation for MOE for the raw Black CVAP total at the 90% level is 922.61 – more than 8 times larger than the MOE the Census Bureau reports (110).

Combining County-level MOE with block groups for split counties

A more accurate way to calculate the MOE for a demonstration district with lots of whole counties is to start with the known MOE calculations from the Census Bureau for all counties that are fully contained a given district. Then we can combine those county-level MOEs with the MOE for any split counties within the district, which we calculate based on the MOEs from block groups that are fully or partially in the split county and thus the district. This is highly likely to inflate the MOE beyond what is actually the case, because as we have already shown relying on block groups as the unit of analysis will inflate the overall MOE. But this is the most accurate methodology we have to calculate MOE for an illustrative district that contains a split county. Also, recall, that several of the block groups included are split across district boundaries so we are unable to precisely estimate the true MOE with the available data.

In the case of Demonstration B-1, of the 9 counties listed above in Table 2, only Pasquotank is split. The method first uses the MOE sum formula for all eight counties and for all 24 Pasquotank block groups that are fully or partially in the illustrative district.[9] This is done to create the numerator component (Black CVAP) of the proportions formula. The data I

[9] Dr. Trende's B-1 analysis erroneously includes two block groups that should not be included in the analysis.

use to generate the district-wide Black CVAP% MOE estimate is listed in Table 3, and are taken from the 2022 ACS.

Rebuttal Table 3. Units and values used to estimate overall Black CVAP% MOE for Demonstration District B-1.

Unit	TotalCVAP	CVAPMOE	BCVAP	BCVAPMOE	PctBlack
Bertie	14705	45	9000	110	61.2
Chowan	10970	180	3705	74.04	33.77
Gates	8290	141	2685	208.01	32.39
Halifax	37655	273	20060	351.97	53.27
Hertford	17180	101	10350	196.51	60.24
Martin	17375	89	7315	143.55	42.1
Northampton	14305	82	7870	225.22	55.02
Warren	15105	81	7640	151.53	50.58
371399601001	890	174	525	140.51	58.99
371399602001	965	305	265	191.06	27.46
371399603001	650	258	525	237.45	80.77
371399604001	435	248	290	219.45	66.67
371399605011	685	275	40	57.72	5.84
371399605021	1740	314	480	226.61	27.59
371399605031	1420	269	420	240.41	29.58
371399607011	1360	406	735	349.28	54.04
371399601002	445	153	245	124.79	55.06
371399602002	475	260	434	255.45	91.37
371399603002	1060	250	625	166.68	58.96
371399604002	410	153	75	97.02	18.29
371399605012	1700	342	355	178.55	20.88
371399605022	1715	376	499	93.28	29.1
371399605032	395	193	215	106.92	54.43
371399606002	920	313	105	149.66	11.41
371399602003	610	189	360	178.55	59.02
371399604003	520	194	240	160.61	46.15
371399605023	1160	344	175	145.67	15.09
371399607013	850	295	320	272.36	37.65
371399602004	1765	217	875	198.35	49.58
371399604004	460	164	220	137.82	47.83
371399606004	2785	710	1450	559.18	52.06
371399604005	1140	451	490	215.46	42.98

To arrive at the final estimate I simply sum down the BCVAP column to generate the numerator and sum the TotalCVAP column to generate the denominator. I then develop the BlackCVAP MOE and TotalCVAP MOE by using the `moe_sum()` formula in tidycensus which essentially takes each individual unit MOE, squares it, then sums all together, then takes the square root. I now have all the necessary estimates to use the `moe_prop()` function discussed above – which generates the BCVAP percentage MOE. This produces an MOE of +/- 0.587 percent – so a bit more than half a percent.

I replicated the analysis for Demonstration District D-1 using the 2022 ACS figures. Using the exact same approach I generate an MOE of +/- 0.594 percent – almost identical to the MOE generated for Demonstration District B-1 – and well below Dr. Trende's estimate of 1.8% at the 90% Confidence Level.

Rebuttal Table 4. Units and values used to estimate overall Black CVAP% MOE for Demonstration District D-1

Unit	TotalCVAP	CVAPMOE	BCVAP	BCVAPMOE	PctBlack
Bertie	14705	45	9000	110	61.2
Gates	8290	141	2685	208.01	32.39
Halifax	37655	273	20060	351.97	53.27
Hertford	17180	101	10350	196.51	60.24
Martin	17375	89	7315	143.55	42.1
Northampton	14305	82	7870	225.22	55.02
Tyrrell	2670	169	990	173.72	37.08
Warren	15105	81	7640	151.53	50.58
Washington	8720	63	4080	135.64	46.79
371399601001	890	174	525	140.51	58.99
371399602001	965	305	265	191.06	27.46
371399603001	650	258	525	237.45	80.77
371399604001	435	248	290	219.45	66.67
371399605011	685	275	40	57.72	5.84
371399605021	1740	314	480	226.61	27.59
371399605031	1420	269	420	240.41	29.58
371399607011	1360	406	735	349.28	54.04
371399601002	445	153	245	124.79	55.06
371399602002	475	260	434	255.45	91.37
371399603002	1060	250	625	166.68	58.96
371399604002	410	153	75	97.02	18.29
371399605012	1700	342	355	178.55	20.88
371399605022	1715	376	499	93.28	29.1
371399605032	395	193	215	106.92	54.43
371399606002	920	313	105	149.66	11.41
371399602003	610	189	360	178.55	59.02
371399604003	520	194	240	160.61	46.15
371399605023	1160	344	175	145.67	15.09
371399607013	850	295	320	272.36	37.65
371399602004	1765	217	875	198.35	49.58
371399604004	460	164	220	137.82	47.83
371399606004	2785	710	1450	559.18	52.06
371399604005	1140	451	490	215.46	42.98

2022 CVAP in Enacted Districts

We can also compare the various percent Black CVAP MOE estimates to known output from the ACS. The ACS produced 2022 CVAP estimates for state legislative districts.[10] Table 5 produces similar estimates as those presented above except specific to each enacted state senate district. Districts 1 and 2 contain respective Black CVAP percentages of 17.86% and 27.46%, along with respective margins of error of 0.28% and 0.33%. Nearby District 5 produces a Black CVAP percentage of 40.53% with an MOE of 0.38%. These numbers look a

[10] https://www.census.gov/programs-surveys/decennial-census/about/voting-rights/cvap/2018-2022-CVAP.html

lot more similar to the Demonstration B-1 and D-1 MOE estimates I produced earlier using the county plus block group MOEs compared to Dr. Trende's MOE estimates.

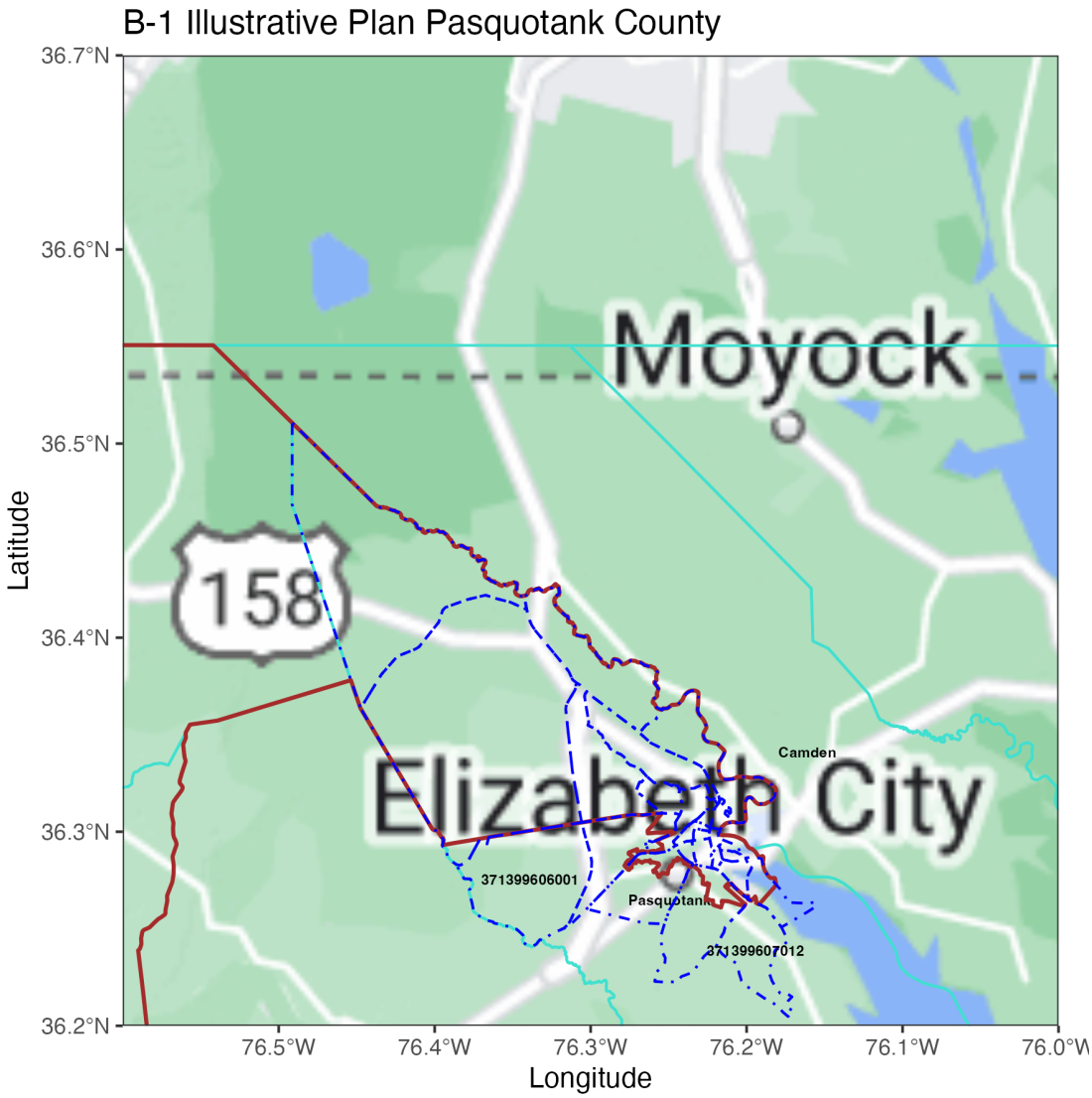
Rebuttal Table 5. MOE analysis for enacted state legislative districts, 2022 CVAP.

District	TotalCVAP	CVAPMOE	BCVAP	BCVAPMOE	PctBlack	P_MOE
Senate District 1	160490	524	28665	458.96	17.86	0.28
Senate District 2	153685	528	42195	523.32	27.46	0.33
Senate District 3	157215	482	68000	591.32	43.25	0.35
Senate District 4	158115	702	58260	697.51	36.85	0.41
Senate District 5	167015	590	67690	681.49	40.53	0.38
Senate District 6	151360	581	22995	836.63	15.19	0.55
Senate District 7	167410	1285	19395	953.57	11.59	0.56
Senate District 8	171150	1254	26545	825.95	15.51	0.47
Senate District 9	148540	745	37810	673.32	25.45	0.43
Senate District 10	153810	898	28210	612.24	18.34	0.38
Senate District 11	155250	524	60190	673.5	38.77	0.41
Senate District 12	142430	998	31160	511.27	21.88	0.32
Senate District 13	139240	3197	27180	1641.94	19.52	1.09
Senate District 14	143505	3906	68105	2987.2	47.46	1.63
Senate District 15	148660	2814	22450	1744.84	15.1	1.14
Senate District 16	131430	2454	16295	1485	12.4	1.11
Senate District 17	133820	2503	16545	1273.43	12.36	0.92
Senate District 18	144530	2874	34450	2170.17	23.84	1.42
Senate District 19	153920	1567	58765	1317.1	38.18	0.76
Senate District 20	148380	2172	44970	1868.12	30.31	1.18
Senate District 21	165520	1498	44630	1421.66	26.96	0.82
Senate District 22	142260	1870	52425	1726.71	36.85	1.11
Senate District 23	158185	766	27950	688.71	17.67	0.43
Senate District 24	147450	459	45670	485.92	30.97	0.32
Senate District 25	160515	1309	29550	680.85	18.41	0.4
Senate District 26	162580	3084	34230	2042.1	21.05	1.19
Senate District 27	152370	2523	49050	1888.41	32.19	1.12
Senate District 28	150100	2827	71845	2212.15	47.86	1.17
Senate District 29	163275	1693	31875	894.23	19.52	0.51
Senate District 30	160595	597	15005	435.09	9.34	0.27
Senate District 31	160085	2041	40305	1596.82	25.18	0.94
Senate District 32	152810	2087	38330	1635.16	25.08	1.01
Senate District 33	157390	753	24210	479.61	15.38	0.3
Senate District 34	153710	1255	32185	683.3	20.94	0.41
Senate District 35	148500	1755	17515	921.24	11.79	0.6
Senate District 36	162465	540	7180	408.2	4.42	0.25
Senate District 37	160695	1438	18600	660.81	11.57	0.4
Senate District 38	148265	3756	70910	2595.28	47.83	1.26
Senate District 39	155475	4110	41705	2951.47	26.82	1.76
Senate District 40	144005	3992	66370	2862.46	46.09	1.52
Senate District 41	151300	3722	63840	2841.54	42.19	1.57
Senate District 42	145115	3081	20180	1727.77	13.91	1.15
Senate District 43	158945	1127	29555	699.37	18.59	0.42
Senate District 44	157135	1003	20245	452.92	12.88	0.28
Senate District 45	164510	1429	12995	595.15	7.9	0.36
Senate District 46	159895	2263	8150	859.22	5.1	0.53
Senate District 47	174700	1574	4355	438.97	2.49	0.25
Senate District 48	157535	612	9120	427.08	5.79	0.27
Senate District 49	156925	2322	11770	778.6	7.5	0.48
Senate District 50	172045	1035	3724	368.06	2.16	0.21

Pasquotank Block Groups in B-1 and D-1

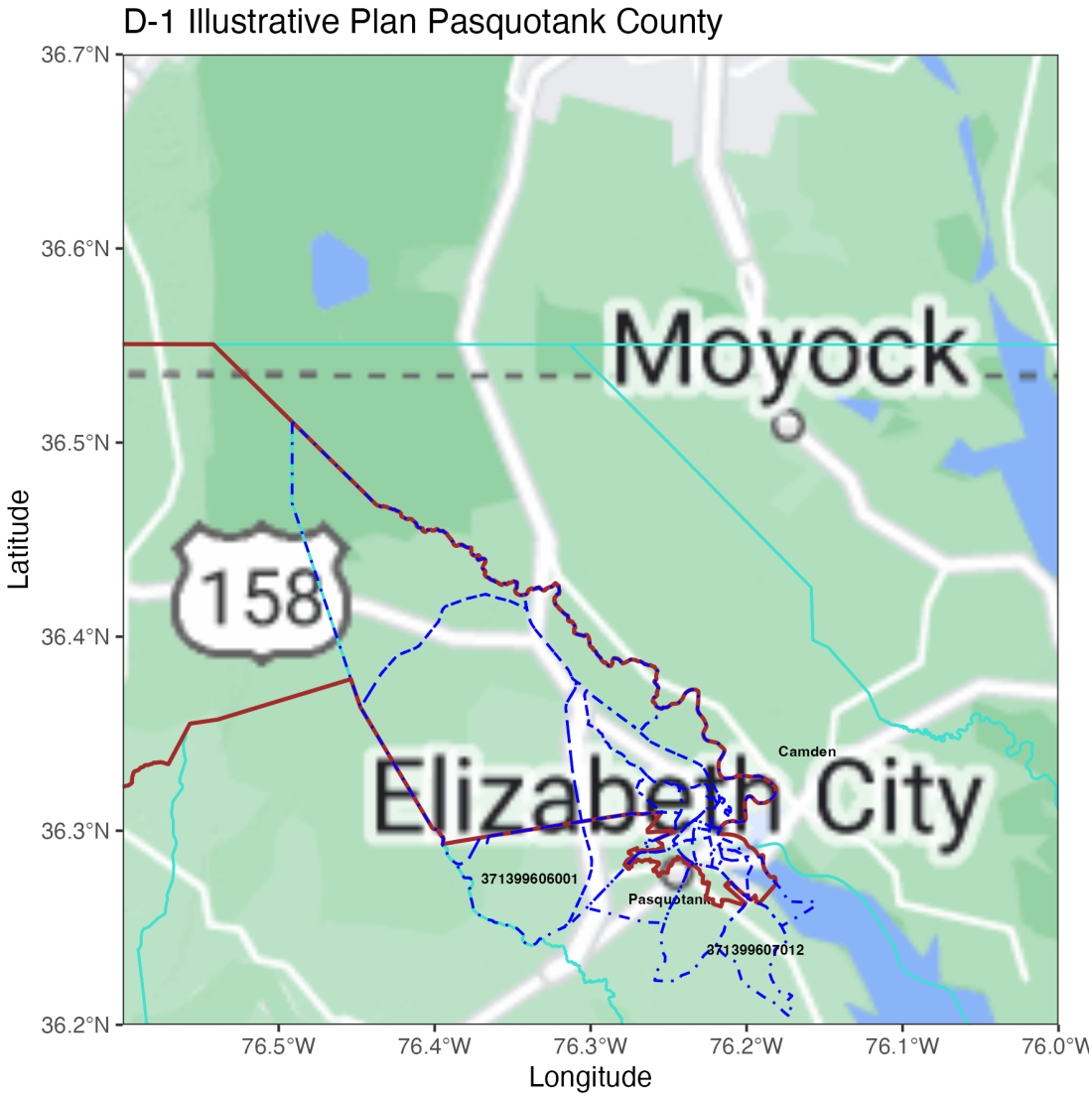
Dr. Trende also analyzes which Pasquotank block groups are contained in Illustrative B-1 and D-1 – indeed he provides a map on page 14 of his report. Looking at this map one can visually see that he includes two block groups that are not in the district but that are adjacent to the district. These block groups are "371399606001" and "371399607012" and are collectively greater than 70% White CVAP. As displayed in Rebuttal Figure 2, one can clearly see that these two block groups (dashed blue line) are outside of the solid brown line boundary and so therefore should not be included in an analysis of B-1.

Rebuttal Figure 2. Trende's Figure 2 replicated with Block Group label for the two block groups that are not in the illustrative plan.



Illustrative D-1 (Rebuttal Figure 3) includes the same configuration, so therefore the same mistake is made. As one can see, the two maps (Figure 2 and 3) are essentially the same.

Rebuttal Figure 3. Trende's Figure 2 replicated with Block Group label for the two block groups that are not in the illustrative plan.



For Illustrative Map B-1, Dr. Trende also excludes three block groups that are included in Mr. Esselstyn's alternative map, two in in Chowan ("370419301020", "370419301010") and one in Bertie ("370159604020"), but these are 0 population block groups.

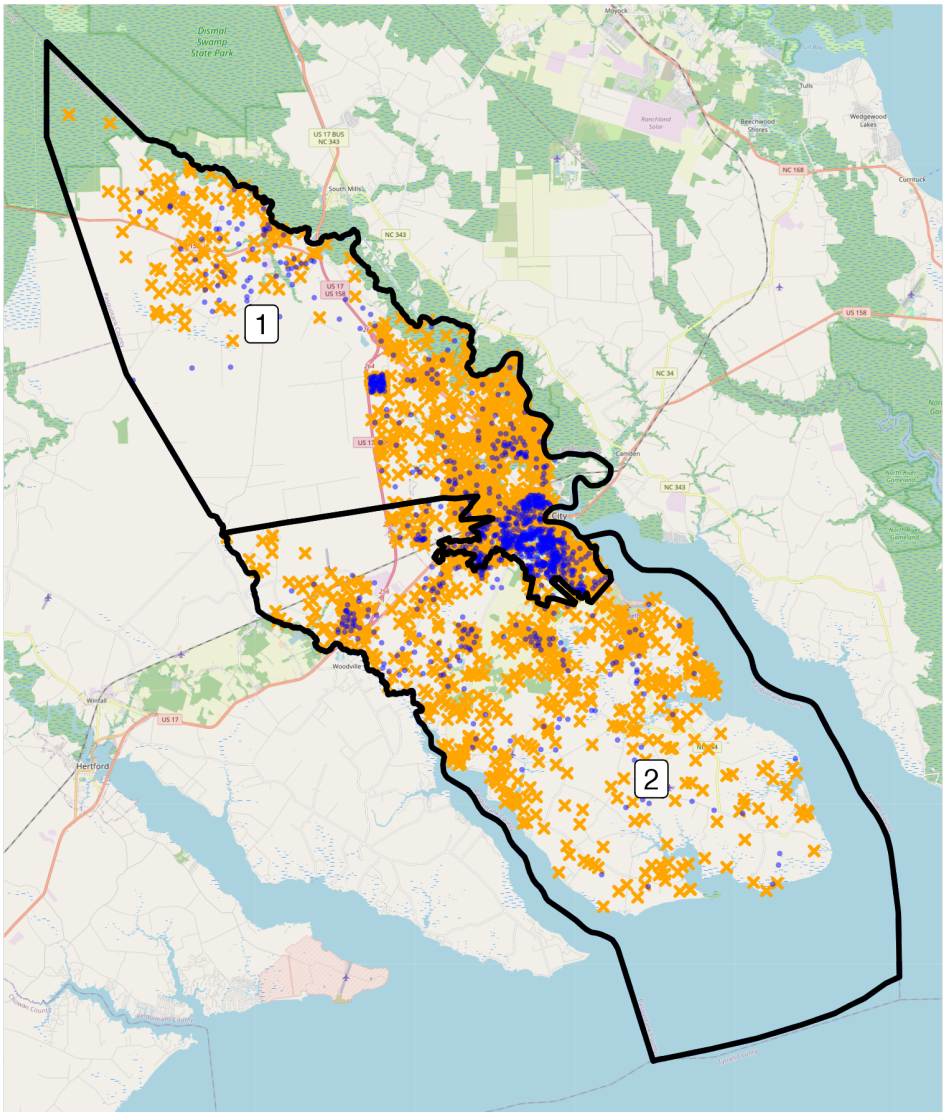
With regards to Illustrative Map D-1, Dr. Trende excludes three block groups with 0 CVAP population, including "370159604020" in Bertie, "371779601000" in Tyrrell, and "371879501000" in Washington.

Dr. Trende's Dotplot Analysis

I have also been asked to examine Dr. Trende's racial dotplot analysis from his report beginning on page 28, labeled Figure 10. I have reproduced Figure 10 below – the plot is

slightly different due to point jittering within each respective block polygon. However, one can visually compare and see that the plots are the same. Based on Dr. Trende's own data, we know that the share of white VAP vs. Black VAP in this area is nearly 60% white VAP vs. 40% Black VAP. That is among just whites and Blacks of voting age in the county, 60% are white and about 40% are Black. However, the dotplot has the effect of making whites appear to be more numerous than they really are producing a visual distortion to the naked eye.

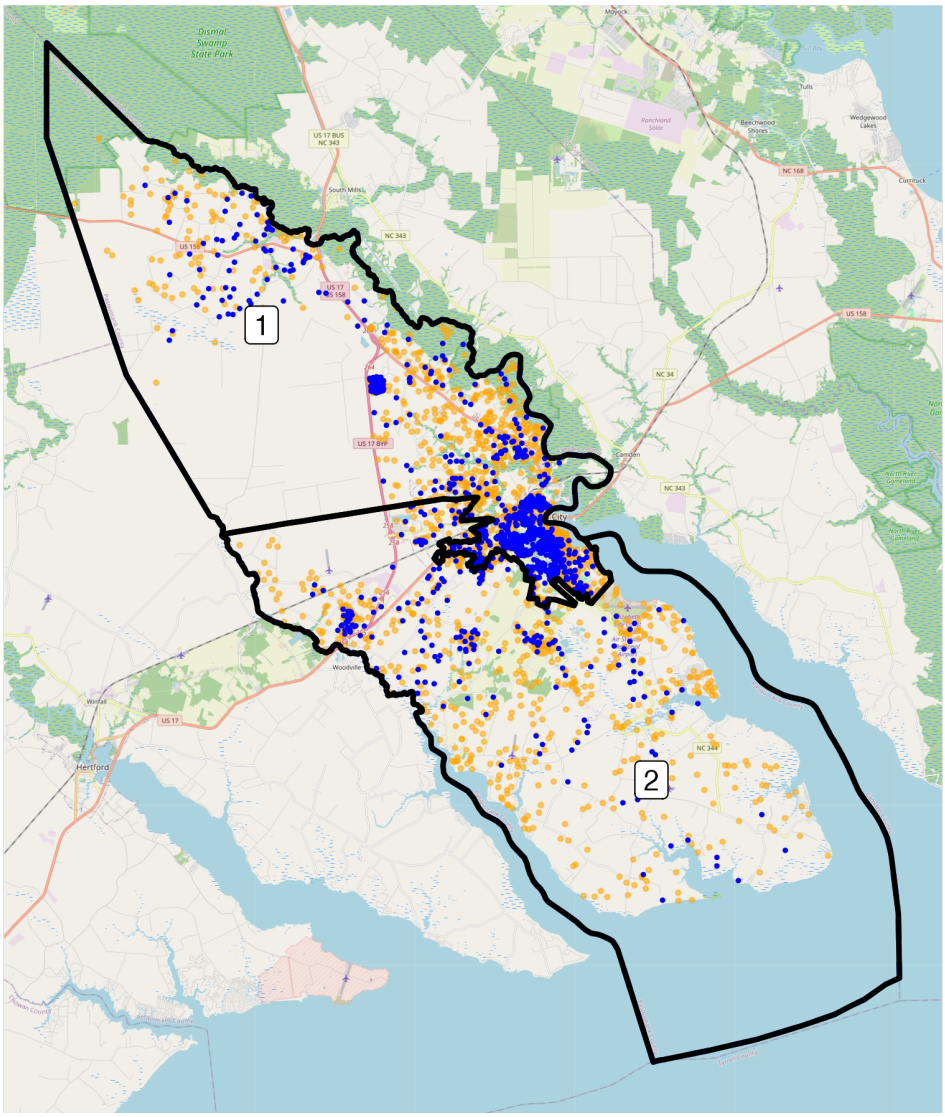
Rebuttal Figure 4. Trende's Figure 16 racial dotplot.



There are a few reasons why this plot produces this effect. One is the visual over-weighting of white (alpha = 1) relative to Black (alpha = .5). Another is that the orange crosses are typically just larger than blue dots. A final parameter called "stroke" also inflates the size of the orange crosses. Rebuttal Figure 5 swaps out the alpha parameters, changes crosses to

dots, and sets stroke off to show a more balanced distribution of people. Based on an ocular inspection, it is hard to dispute that the blue dots in the plot below make one think the Black population is closer to the 40% mark relative to the distortion in Rebuttal Figure 4.

Rebuttal Figure 5. Trende's Figure 16 racial dotplot with alpha parameters swapped between whites and Blacks.



Pitt and Edgecombe State Senate District 5 Performance Analysis

In response to Dr. Trende's statements about the Pitt and Edgecombe district (Senate District 5), I have been asked to opine on whether enacted State Senate District 5 is a performing district. To evaluate this I conducted an electoral performance analysis similar to those that I conducted in my Collingwood May Report.

Figure 6 produces the results for the 2022 statewide contests subset to Edgecombe and Pitt counties – which comprise Senate District 5. The results show that the Black-preferred candidate wins 7 of 7 contests.

Rebuttal Figure 6. Electoral Performance Results, 2022, Enacted District 5 (Edgecombe and Pitt Counties)

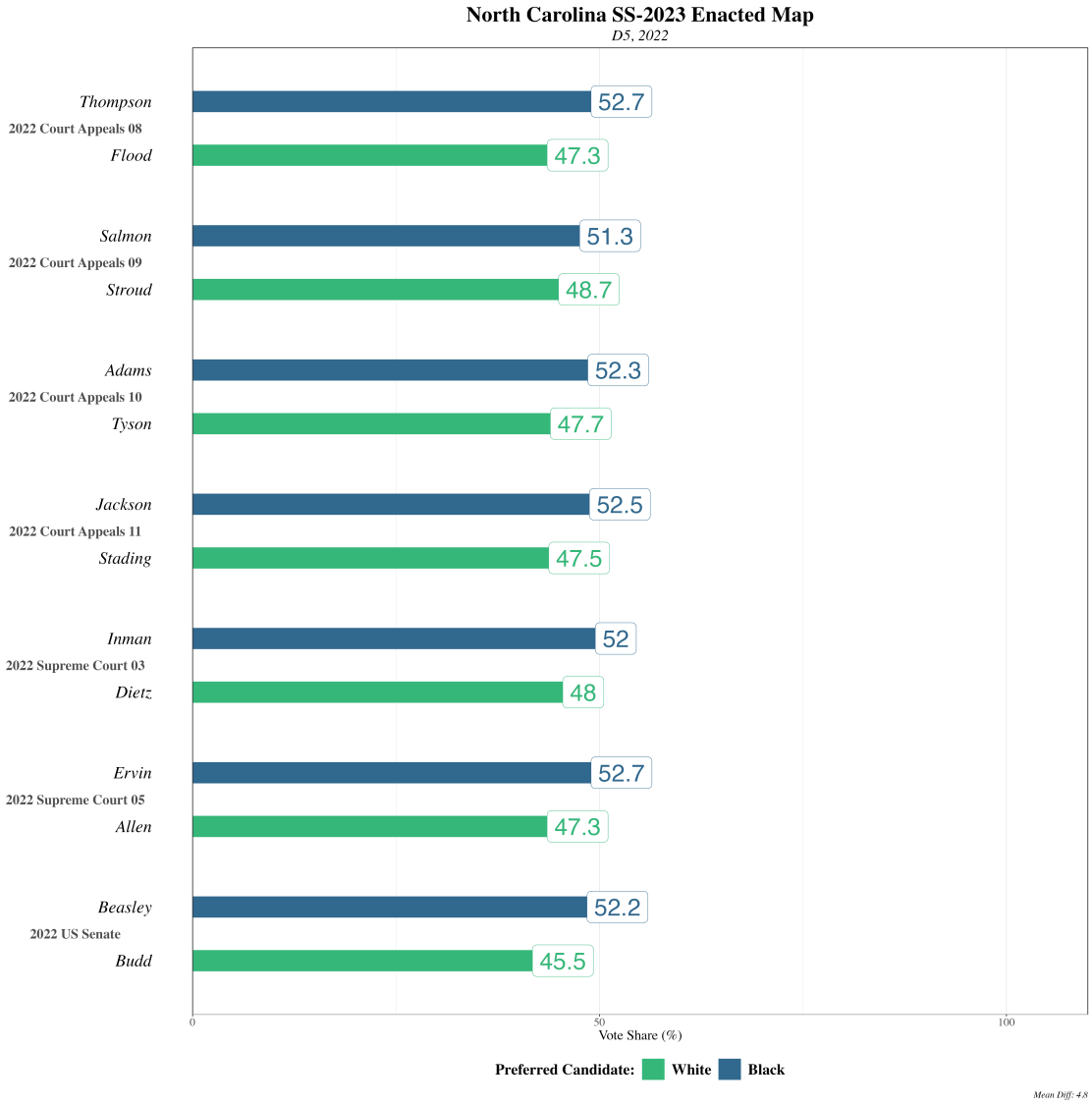


Figure 7 shows 2020 performance results in enacted District 5. The Black-preferred candidate wins every single contest.

Rebuttal Figure 7. Electoral Performance Results, 2020, Enacted District 5 (Edgecombe and Pitt Counties)

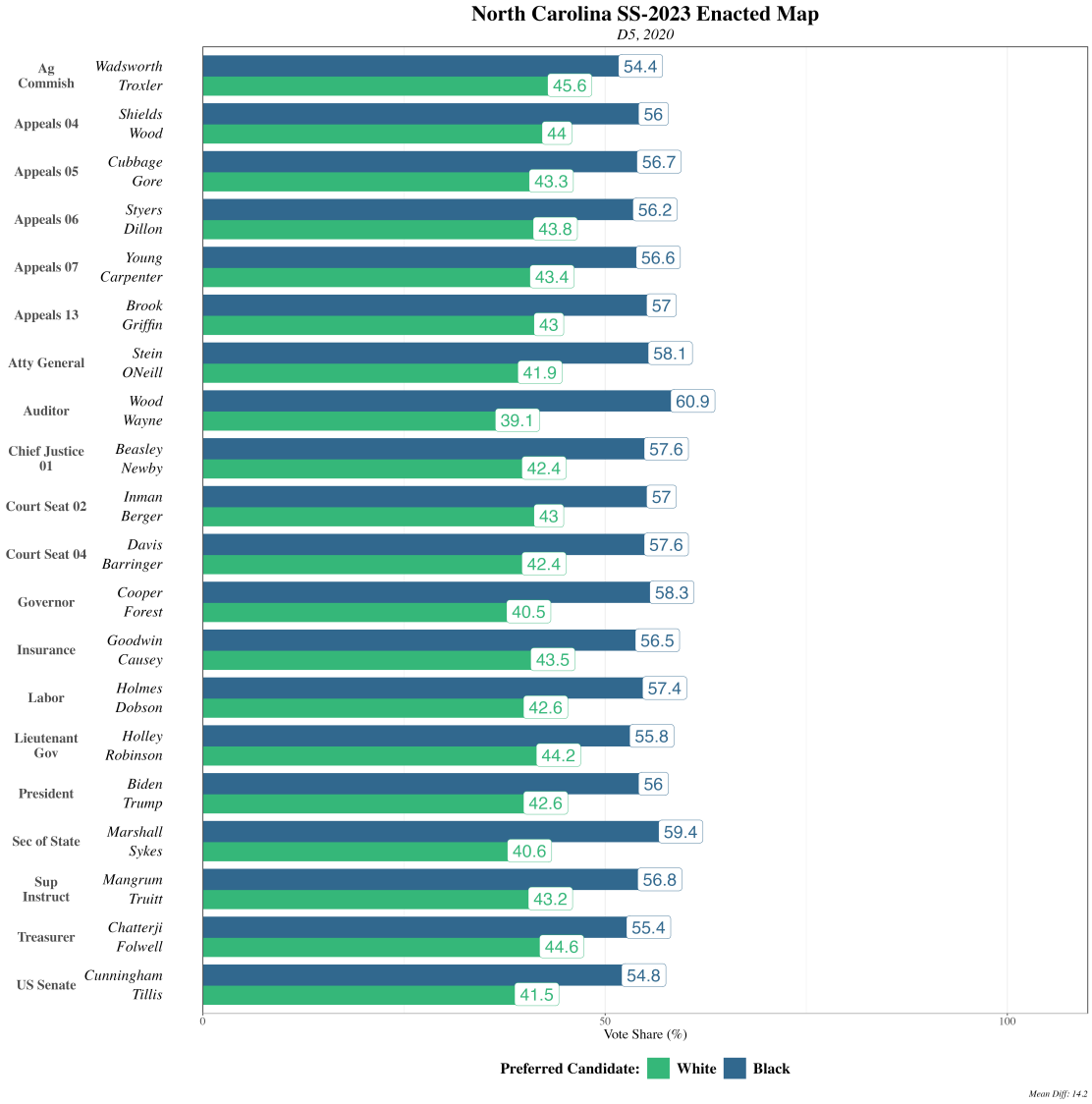


Figure 8 shows 2018 performance results in enacted District 5. The Black-preferred candidate wins every single contest.

Rebuttal Figure 8. Electoral Performance Results, 2018, Enacted District 5 (Edgecombe and Pitt Counties)

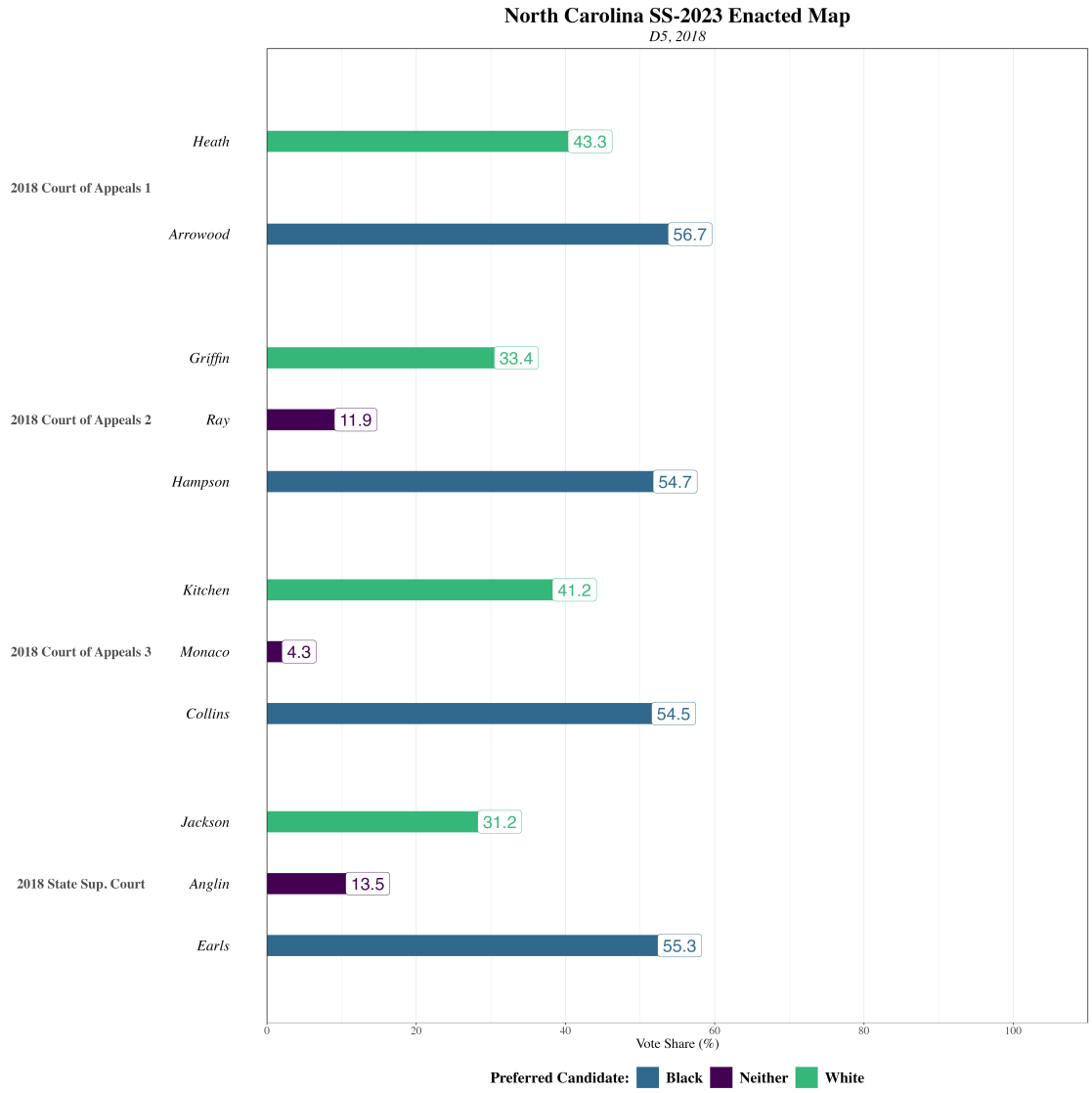
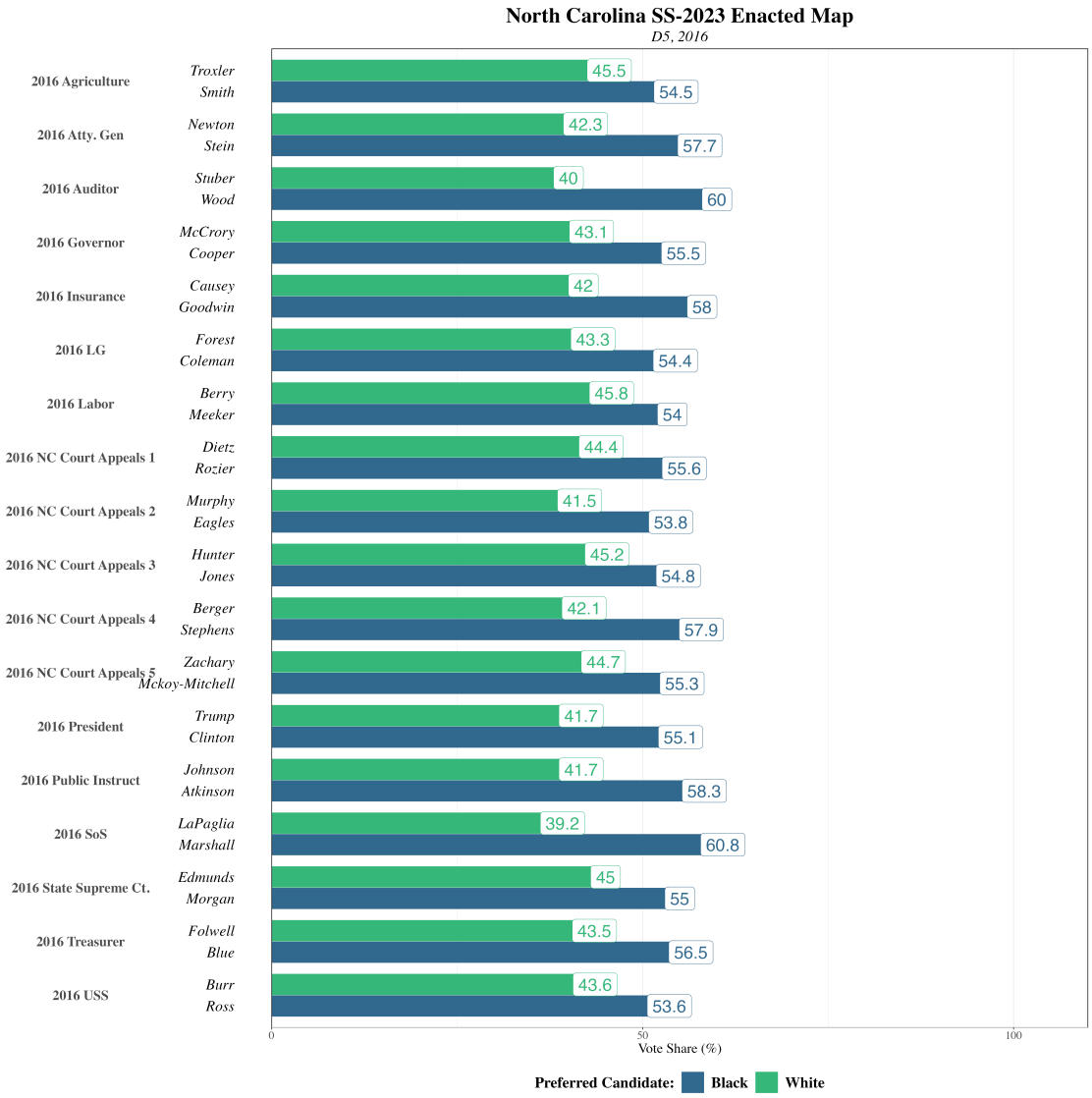


Figure 9 shows 2020 performance results in enacted District 5. The Black-preferred candidate wins every single contest.

Rebuttal Figure 9. Electoral Performance Results, 2016, Enacted District 5 (Edgecombe and Pitt Counties)



Thus, without question, enacted State Senate District 5 is a Black-opportunity district – as the Black-preferred candidate won every single contest I examined across four election cycles.

Demonstrative District E

Plaintiff's counsel provided me an illustrative District E. In this section I assess the margin of error that applies to a calculation of the district's Black CVAP%, based on the MOE for counties and block groups using the same method I applied above. I used the 2022 CVAP

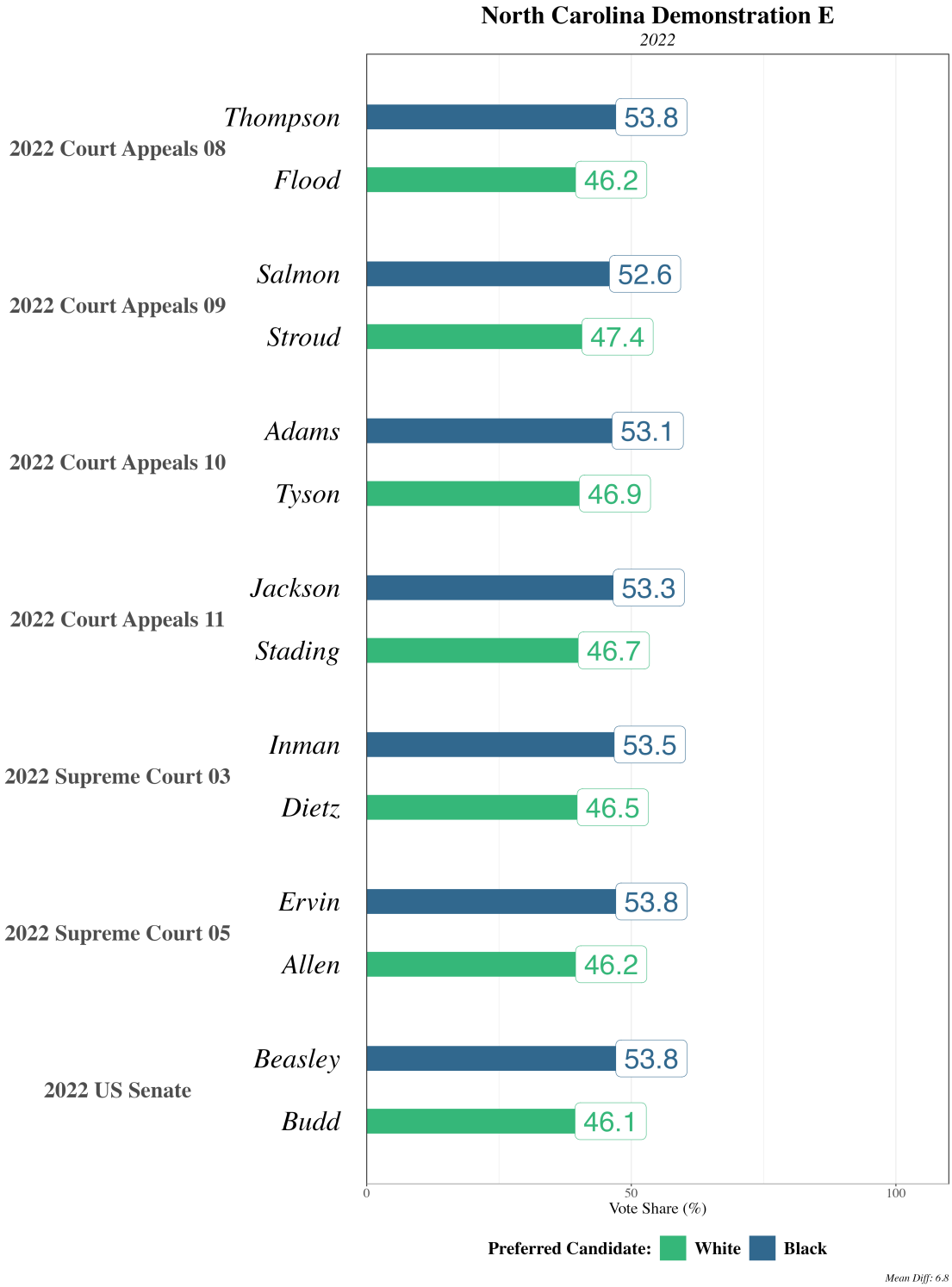
data. Then I conduct an electoral performance analysis similar to what I did in my Collingwood May Report.

To assess the overall district Black CVAP proportion MOE, I use the county and block group method used above to calculate the MOE at 90% and 95% confidence intervals around this method. Recall, this method takes known county level MOE estimates – which in this district is 9 full counties and then the block group MOEs of the one county that the district splits (Pasquotank). There are 25 block groups that are fully inside of the illustrative map or overlap at least a part of the district. The reported 90% CI MOE from this calculation yields +/- 0.601%, whereas the 95% estimate produces +/- 0.716%.

Electoral Performance of Illustrative District E

I also conducted an electoral performance analysis of District E. The 2022 results are shown below in Figure 10 – the Black-preferred candidates wins all seven contests included.

Rebuttal Figure 10. Electoral Performance Results, 2022, Illustrative District E.



In 2020, the Black-preferred candidate wins every single contest, as shown in Figure 11.

Rebuttal Figure 11. Electoral Performance Results, 2020, Illustrative District E.

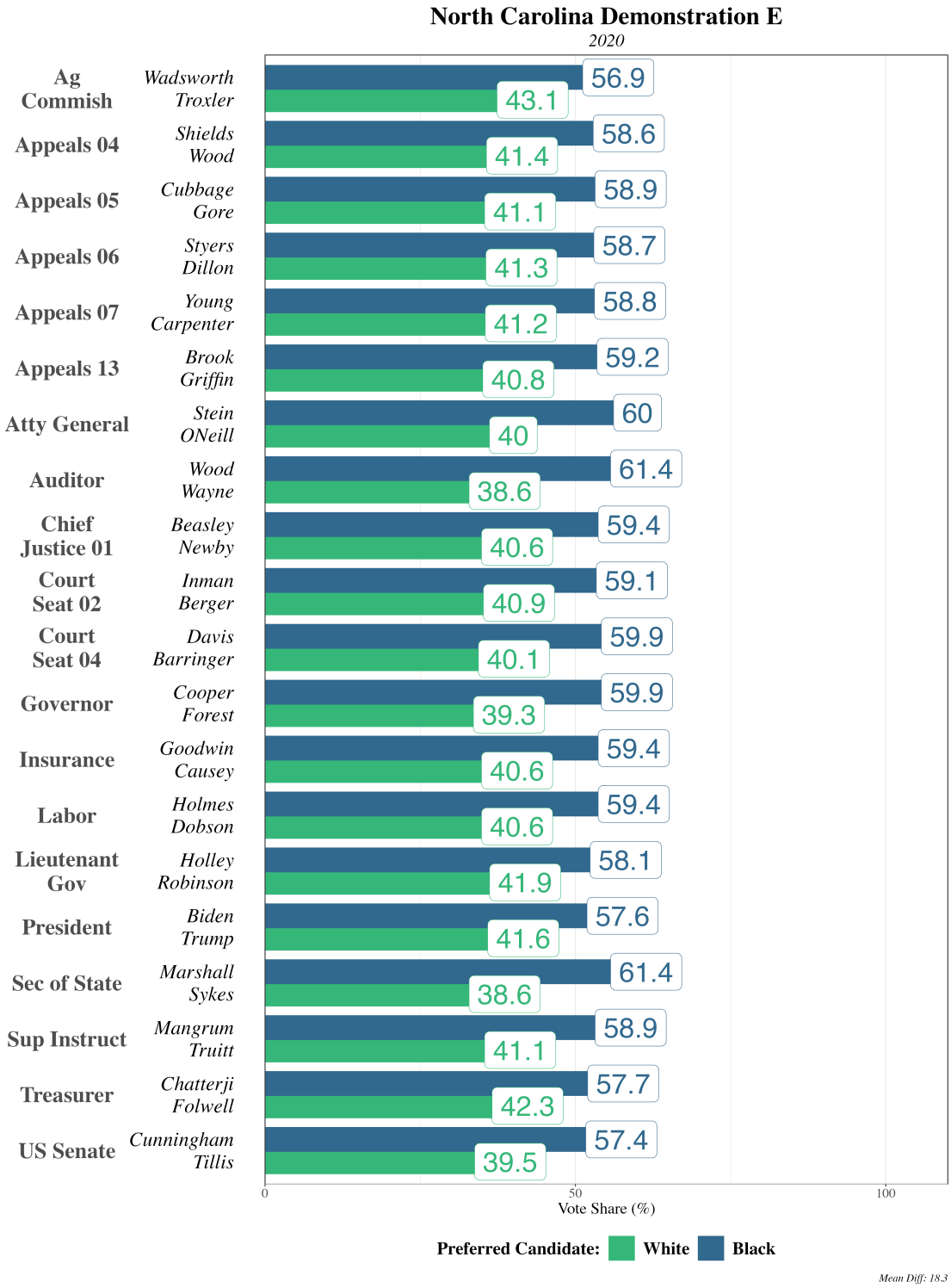
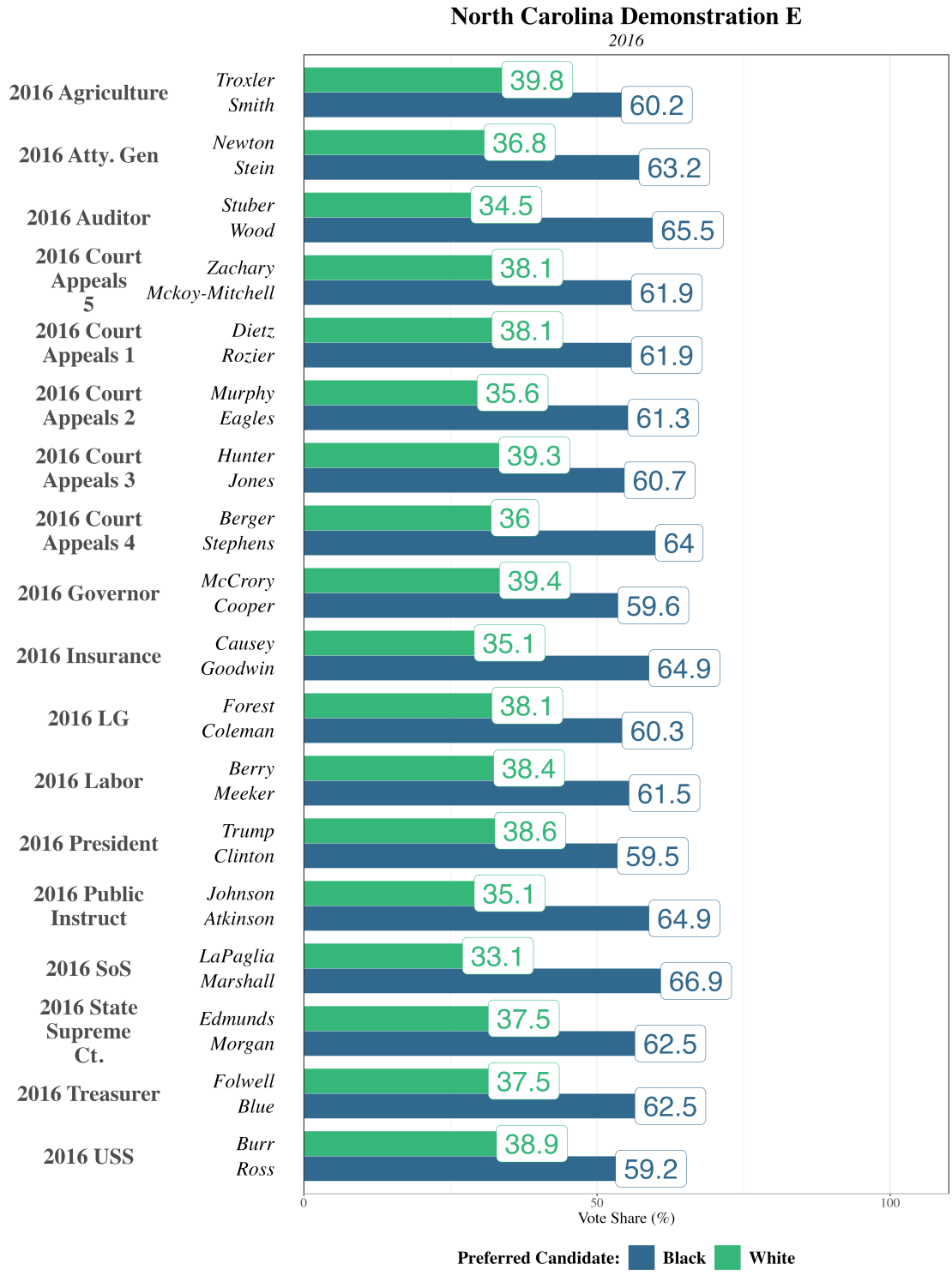


Figure 12 presents the 2018 results, which shows a similar pattern as 2020 and 2022.

Rebuttal Figure 12. Electoral Performance Results, 2018, Illustrative District E.

Figure 13 presents the 2016 results, which shows that District E performs for Black voters in every single election contest.

Rebuttal Figure 13. Electoral Performance Results, 2016, Illustrative District E.



Thus, Illustrative District E performs electorally for Black-preferred candidates.

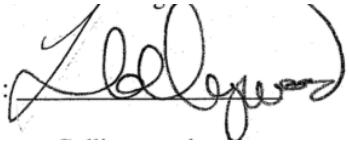
Conclusion

In conclusion, my RPV results show that Black voters strongly prefer one set of candidates, whereas white voters prefer a different set of candidates. This occurs in the demonstration area, as well as in State Senate Districts 1 and 2. This region of North Carolina is characterized by extreme RPV. Furthermore, white voters typically demonstrate less cross-over voting for Black-preferred candidates when the candidate is Black compared to when that candidate is white.

Due to this extreme RPV, the suggestion that one could draw a 37% BVAP district in this part of the state that will electorally perform Black voters is not supported. The fact that the Black-preferred candidate achieves a slight majority of the vote in a few precincts around the 37% BVAP level tells us nothing about whether a district would perform at that level.

Turning to Dr. Trende's analysis, I have demonstrated in multiple ways that his margin of error analysis is unreliable and extremely misleading as to the true MOE in various illustrative districts. Using more reliable methods, the 2022 ACS shows that the MOE for the Black CVAP% for the latest illustrative map (Demonstration District E) is +/- 0.601% at the 90% confidence interval, and +/- 0.716% at the 95% confidence interval, meaning that Demonstration District E achieves a Black CVAP% point estimate that is above 50% taking into account the margin of error at both the 90% and 95% confidence level. Moreover, the district electorally performs for Black-preferred candidates.

Pursuant to 28 U.S.C. § 1746, I declare that the foregoing is true and correct to the best of my knowledge and belief.



Dr. Loren Collingwood

August 30, 2024